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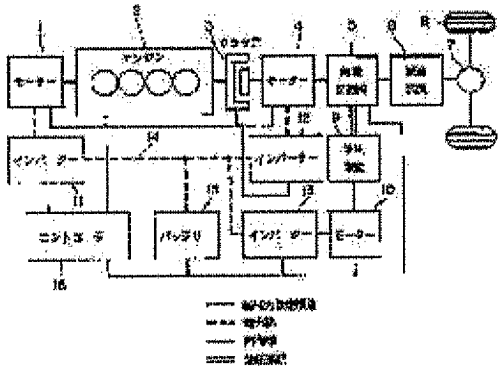
(54) CONTROL DEVICE FOR HYBRID VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To inhibit the occurrence of a torque stage difference in finishing a regeneration by constituting a throttle driving device such that it is controlled to a throttle open degree corresponding to an engine revolution number at the regeneration operation in a control device in which a fuel supplying to an internal combustion engine is stopped at the time of a speed decrease and a rotating motor is regeneration-operated.



SOLUTION: A true target torque is calculated by adding/decreasing a driving force generated by a motor 4 against the target torque based on an operation quantity of an accelerator pedal during a vehicle driving. A volume flow rate of a suction air required in every one cycle is determined based on the target torque and an engine revolution number at this time and a required opening area of a suction tube is searched by a table. The opening area corresponding to a sum suctioned air quantity is determined by multiplying the engine revolution number and a cylinder volume to the required opening area to determine a throttle valve open degree. At this time, at the time of a speed

decrease that a fuel cut is carried out, the throttle open degree at the time of the fuel cutting searched by a table from the engine revolution number is outputted as a target throttle open degree.

CLAIMS

[Claim(s)]
[Claim 1]A control device of a hybrid vehicle constituted so that it might control in a hybrid vehicle to a throttle opening which defined said throttle drive according to engine speed at the time of said regenerative operation characterized by comprising the following.
A throttle drive which is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status.
Regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out.

[Claim 2]A control device of a hybrid vehicle constituted so that it might control to a throttle opening from which predetermined intake pipe negative pressure which defined said throttle drive beforehand at the time of said regenerative operation is acquired in a hybrid vehicle characterized by comprising the following.
A throttle drive which is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status.
Regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out.

[Claim 3]A control device of a hybrid vehicle constituted so that it might control in a hybrid

vehicle to a throttle opening which defined said throttle drive according to engine speed and the amount of target regeneration at the time of said regenerative operation characterized by comprising the following.
A throttle drive which is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status.
Regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out.

[Claim 4]A control device of a hybrid vehicle constituted so that it might control to a throttle opening from which intake pipe negative pressure which defined said throttle drive according to engine speed and the amount of target regeneration at the time of said regenerative operation is acquired in a hybrid vehicle characterized by comprising the following.
A throttle drive which is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status.
Regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out.

[Claim 5]In a hybrid vehicle characterized by comprising the following, a difference of real torque of an internal-combustion engine and target torque is calculated based on engine speed and a target throttle opening at the time of an end of a regenerative operation, A control device of a hybrid vehicle provided with a control device which drives a dynamo-electric machine and offsets this torque difference so that driving force equivalent to this torque difference may be produced.
A throttle drive which is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status.
Regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out.

[Claim 6]A control device of a hybrid vehicle given in any of claims 1, 3, and 4 constituted so that engine speed becomes low and a throttle drive may reduce a throttle opening they are.
[Claim 7]A control device of the hybrid vehicle according to claim 3 or 4 set up according to a state of a battery where the amount of target regeneration drives a dynamo-electric machine.
[Claim 8]A control device of the hybrid vehicle according to any one of claims 1 to 4 characterized by comprising the following.
An accelerator sensor with which a throttle drive detects a control input of an accelerator pedal.
An actuator which drives a throttle valve.
A control device which drives said actuator based on a manipulated variable signal from an accelerator sensor.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the throttle control device of a hybrid vehicle.
[0002]
[Description of the Prior Art]It has simultaneously as a motor an internal-combustion engine and a dynamo-electric machine (electric motor which functions also as a dynamo), The hybrid vehicle it was made to run with the driving force of either or both sides is known (for example, refer to railroad Japan issue "automotive engineering" VOL.46 No.7 June, 1997 item 39 - 52 pages).
[0003]In the so-called hybrid vehicle of such a parallel method. In the operation area where load is fundamental comparatively small, it runs only with an electric motor, if load increases, an internal-combustion engine will be started, necessary driving force will be secured, and the maximum driving force is demonstrated by using together an electric motor and an internal-combustion engine if needed.
[0004]By the way, when a driver drives an electric motor with the reverse driving force from a drive system at the time of the slowdown which returned the accelerator pedal and makes it generate electricity, regenerative operation which charges a battery is performed. This tends to raise energy efficiency, securing slowdown power using the load at the time of power generation by an electric motor in addition to the engine brake action by internal friction of an internal-combustion engine. It is better to have lessened the operation of engine braking as much as possible, and only for that part to increase generating load, in order to raise the efficiency of this regenerative operation more. From such a viewpoint, while suspending the fuel supply to an internal-combustion engine at the time of regeneration, there are some which make a throttle opening the maximum and reduced the friction loss by pump loss.
[0005]However, since it will become the resumption of fuel supply from the state where suction

air quantity is large when regenerative operation is completed and the fuel supply to an internal-combustion engine is resumed if a throttle is made full admission in this way, as opposed to the output which a driver demands at the time -- an output -- it becomes excessive, a torque level difference occurs, and there is a possibility of giving a crew member displeasure. That result from the operation delay of the actuator which controls a throttle opening, and an air content does not immediately decrease also becomes a factor which promotes generating of a torque level difference.

[0006]This invention was made paying attention to such a problem, and an object of this invention is to control generating of the torque level difference at the time of the end of regeneration.

[0007]

[Means for Solving the Problem]A throttle drive which an invention of claim 1 is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status, Fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and in a hybrid vehicle provided with regenerative control equipment to which the regenerative operation of said dynamo-electric machine is carried out, it constitutes so that it may control to a throttle opening which defined said throttle drive according to engine speed at the time of said regenerative operation.

[0008]A throttle drive which an invention of claim 2 is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status, In a hybrid vehicle provided with regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out, It constitutes so that said throttle drive may be controlled to a throttle opening from which predetermined intake pipe negative pressure beforehand defined at the time of said regenerative operation is acquired.

[0009]A throttle drive which an invention of claim 3 is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status, In a hybrid vehicle provided with regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out, It constitutes so that it may control to a throttle opening which defined said throttle drive according to engine speed and the amount

of target regeneration at the time of said regenerative operation.
[0010]A throttle drive which an invention of claim 4 is constituted so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status, In a hybrid vehicle provided with regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out, It constitutes so that said throttle drive may be controlled to a throttle opening from which intake pipe negative pressure defined according to engine speed and the amount of target regeneration at the time of said regenerative operation is acquired.
[0011]A throttle drive which comprises an invention of claim 5 so that driving force of either one of an internal-combustion engine or a dynamo-electric machine, and both sides may be transmitted to a driving system of vehicles, and controls a throttle opening of an internal-combustion engine according to operational status, In a hybrid vehicle provided with regenerative control equipment to which fuel supply to an internal-combustion engine connected with a driving system at the time of a slowdown is suspended, and the regenerative operation of said dynamo-electric machine is carried out, Based on engine speed and a target throttle opening at the time of an end of a regenerative operation, a difference of real torque of an internal-combustion engine and target torque is calculated, and it has composition which drives a dynamo-electric machine and offsets this torque difference so that driving force equivalent to this torque difference may be produced.
[0012]In invention [which / of above-mentioned claims 1, 3 and 4], an invention of claim 6 is constituted so that engine speed becomes low about a throttle drive, and a throttle opening may be reduced.
[0013]An invention of claim 7 sets up the amount of target regeneration in an invention of above-mentioned claim 3 or 4 based on a state of a battery of driving a dynamo-electric machine.
[0014]An accelerator sensor with which an invention of claim 8 detects a control input of an accelerator pedal for the throttle drive in invention [which / of above-mentioned claims 1-4], It should have an actuator which drives a throttle valve, and a control device which drives said actuator based on a manipulated variable signal from an accelerator sensor.
[0015]
[Function and Effect]In the invention of above-mentioned claim 1, when predetermined regeneration conditions are satisfied, generally the drive system and internal-combustion engine of vehicles are connected, When a slowdown is started by operation in which a driver returns an accelerator pedal from the operational status beyond a predetermined value in

engine speed or the vehicle speed, the fuel supply to an internal-combustion engine is suspended, and the regenerative operation by power generation of a dynamo-electric machine is started. The throttle opening between this regenerative operation is decided based on engine speed rather than is constant. Such throttle control is based on the throttle drive which consists of a control device etc. which control an accelerator sensor as shown, for example in claim 8, the actuator which drives a throttle, and an actuator, It is realizable by composition which amends the driving signal to an actuator based on engine speed.

[0016]In order to raise the efficiency of regeneration and to reduce the pump loss of an internal-combustion engine, it is as having mentioned above that it is desirable to open a throttle and to reduce the intake pipe negative pressure of the downstream. However, as shown in drawing 5, intake pipe negative pressure changes according to the engine speed Ne, and even if it is the same throttle opening, it progresses as the time of a high velocity revolution. If intake pipe negative pressure shall be kept constant, a throttle opening will decrease like the time of a low speed.

[0017]Therefore, making a throttle opening into the minimum by closing a throttle as the time of a low speed rotary, and controlling it to a degree, as fundamentally shown in the invention of claim 6, the less than intake pipe negative pressure which does not produce pump loss, for example, -100 mmHg, is maintained, and high regenerative efficiency can be secured. By doing in this way and maintaining a throttle opening to the minimum, For example, engine intake air quantity when regenerative operation is completed by a driver's braking operation etc. is controlled, and delay of the actuator which controls a throttle opening can be made into the minimum, and torque level difference generating at the time of resumption of fuel supply can be suppressed.

[0018]In pump loss, the ways which generated the intake pipe negative pressure of the grade which is a specific rotational area depending on organizations, such as an organization which has a rotational area where a high compression ratio organization and intake air charging efficiency increase, may decrease in number. That is, although the above-mentioned control which reduces a throttle opening according to the fall of engine speed is generally effective, the characteristic of the optimal throttle opening to actual engine speed can become a different thing according to the character of each organization.

[0019]In the invention of claim 2, at the time of the same regenerative operation as the above, feedback control of the throttle opening is carried out so that intake pipe negative pressure may serve as a predetermined value defined beforehand. In this case, since a throttle opening is controlled so that target intake pipe negative pressure is acquired irrespective of engine speed, based on the intake pipe negative pressure strongly correlated in generating of pump loss, it is controllable by the desirable throttle opening which does not produce a torque level difference with sufficient accuracy, raising regenerative efficiency.

[0020]Based on the intake pipe negative pressure defined based on engine speed, the amounts of target regeneration, or such quantity, a throttle opening is controlled by the invention of claim 3 or 4. The amount of target regeneration is a desired value of the charge to the battery which drives a dynamo-electric machine, therefore is defined based on the charging state of the battery at that time like the invention of claim 7.
[0021]Since the amount of target regeneration becomes small when the battery is fully charged, the generating loads of a dynamo-electric machine are decreasing in number so much. When control which opens a throttle in such a state and makes pump loss of an internal-combustion engine small is performed, there is a possibility that slowdown power may be insufficient and a feeling of free running may arise. Since it becomes controllable [which extracts a throttle opening based on the size of the amount of target regeneration] according to this point and this invention, While the effect which cancels a torque level difference is acquired raising regenerative efficiency like each above-mentioned invention when regeneration is required, when there are few amounts of required regeneration, engine brake action sufficient by the internal-combustion engine side is generated, and a moderate slowdown operation can be secured.
[0022]Since intake pipe negative pressure is fed back, a throttle opening can be controlled with more sufficient accuracy by the invention of claim 4 like the invention of claim 2.
[0023]According to the invention of claim 5, when a slowdown is completed by accelerator pedal operation by a driver by the deceleration process under regenerative operation, generating of a torque level difference when regenerative operation is terminated in the middle of a slowdown is erased among them by the output torque of a dynamo-electric machine. That is, a big torque level difference may occur with resumption of fuel supply by regeneration discontinuation with a deviation with a actual throttle opening, the output torque of an internal-combustion engine, i.e., the target throttle opening, which a driver demands as accelerator operation being performed during regenerative operation at the time. On the other hand, since according to this invention a dynamo-electric machine drives so that the aforementioned torque difference may be computed based on the target throttle opening and engine speed at the time of said regeneration discontinuation and this may be offset, the driving force of vehicles is smoothly controllable irrespective of such a driver's operation.
[0024]
[Embodiment of the Invention]The embodiment of this invention is described based on a drawing below. The example of composition of the hybrid vehicle which can apply the invention in this application is first shown in drawing 1 - drawing 4. These are the hybrid vehicles of the parallel method each runs using the power of either one of an engine (internal-combustion engine) or an electric motor (dynamo-electric machine) and both sides according to a travel condition.

[0025]In drawing 1, a thick solid line shows the channels of communication of mechanical power, and a thick dashed line shows a power line. A thin solid line shows the control line and the double line shows a hydraulic system. The power train of these vehicles comprises the motor 1, the engine 2, the clutch 3, the motor 4, the nonstep variable speed gear 5, the reduction gear 6, the differential gear 7, and the driving wheel 8. The output shaft of the motor 1, the output shaft of the engine 2, and the input shaft of the clutch 3 are connected mutually, and the output shaft of the clutch 3, the output shaft of the motor 4, and the input shaft of the nonstep variable speed gear 5 are connected mutually.
[0026]The engine 2 and the motor 4 serve as a propulsion source of vehicles at the time of clutch 3 conclusion, and only the motor 4 serves as a propulsion source of vehicles at the time of clutch 3 release. The driving force of the engine 2 or the motor 4 is transmitted to the driving wheel 8 via the nonstep variable speed gear 5, the reduction gear 6, and the differential gear 7. Pressure oil is supplied to the nonstep variable speed gear 5 from the hydraulic system 9, and the clamp and lubrication of a belt are made. The lubricating oil pump (not shown) of the hydraulic system 9 is driven by the motor 10.
[0027]The motor 1 is mainly used for engine start and power generation, and the motor 4 is mainly used for promotion (it is also called the power running.) and braking of vehicles. The motor 10 is an object for the lubricating oil pump drive of the hydraulic system 9. At the time of clutch 3 conclusion, the motor 1 can also be used for promotion and braking of vehicles, and the motor 4 can also be used for engine start or power generation. The clutch 3 is a powder clutch and can adjust transmitting torque. The nonstep variable speed gears 5 are nonstep variable speed gears, such as a belt type and a toroidal type, and can adjust a change gear ratio without going through stages.
[0028]The motors 1, 4, and 10 are driven with the inverters 11, 12, and 13, respectively. In using a direct-current electric motor for the motors 1, 4, and 10, it uses a DC to DC converter instead of an inverter. While the inverters 11-13 are connected to the main battery 15 via common DC link 14, changing the direct-current charging power of the main battery 15 into alternating current power and supplying the motors 1, 4, and 10, The exchange generated output of the motors 1 and 4 is changed into direct current power, and the main battery 15 is charged. Since the inverters 11-13 of each other are connected via DC link 14, the electric power generated by the motor under regenerative operation can be directly supplied to the motor under power running, without passing the main battery 15. Various cells, such as a lithium ion battery, a nickel hydoride battery, and a lead battery, and an electrical machinery double layer capacitor ******** power capacitor are applied to the main battery 15.
[0029]The controller 16 is what has a function as regenerative control equipment of this invention, It has a microcomputer, its periphery article, various actuators, etc., and has simultaneously a function which controls the transmitting torque of the clutch 3, the revolving

speed of the motors 1, 4, and 10 and output torque, the change gear ratio of the nonstep variable speed gear 5, the fuel oil consumption and fuel injection timing of the engine 2, ignition timing, etc.

[0030]For the controller 16, as shown in drawing 2, The key switch 20, the selection lever switch 21, the accelerator pedal sensor 22, the brake switch 23, the speed sensor 24, the battery temperature sensor 25, the battery SOC sensing device 26, the engine speed sensor 27, and the throttle opening sensor 28 are connected. If the key of vehicles is set as 0N position or a start position, the closed circuit of the key switch 20 will be carried out (they are OFF or OFF, and **** about one or 0N, and an open circuit in the closed circuit of the following and a switch). The one [the selection lever switch 21 / one switch of P, N, R, and D] according to the setting-out position of the select lever (not shown) switched to which range of the parking P, the neutral N, the reverse R, and drive D.

[0031]The accelerator pedal sensor 22 detects the control input of an accelerator pedal, and the brake switch 23 detects the treading-in state (switch one at this time) of a brake pedal. The speed sensor 24 detects the travel speed of vehicles, and the battery temperature sensor 25 detects the temperature of the main battery 15. The battery SOC sensing device 26 detects SOC (State Of Charge) which is a central value of the net volume of the main battery 15. The engine speed sensor 27 detects the number of rotations of the engine 2, and the throttle opening sensor 28 detects the throttle valve of the engine 2.

[0032]The fuel injection equipment 30 of the engine 2, the ignition 31, the good change valve gear 32, etc. are connected to the controller 16. The controller 16 drives the ignition 31 and performs ignition timing control of the engine 2 while it controls the fuel injection equipment 30 and adjusts supply, a stop, and fuel oil consumption and fuel injection timing of the fuel for the engine 2. The controller 16 functions as a control device of the throttle drive which control the good change valve gear 32, and the operating state of the intake/exhaust valve of the engine 2 is adjusted, and also is mentioned later. A power supply is supplied to the controller 16 from the low-pressure auxiliary battery 33.

[0033]Drawing 3 or drawing 4 is a figure showing the example of arrangement of a power train. The motor 1 of the input side of the clutch 3 and arrangement of the engine 2 may arrange the motor 1 upstream of the engine 2, as shown in drawing 3, and as shown in drawing 4, they may arrange the motor 1 downstream from the engine 2. In the example of arrangement shown in drawing 3, while linking the output shaft of the engine 2 directly with the input shaft of the clutch 3 and constituting from one axis, the output shaft of the engine 2 is connected with the output shaft and belt of the motor 1, or the gear. The rotor of the motor 1 is penetrated, the output shaft of the engine 2 is directly linked with the input shaft of the clutch 3, and one axis constitutes the input side of the clutch 3 from the example of arrangement shown in drawing 4.

[0034]On the other hand, the motor 4 of the output side of the clutch 3 and arrangement of the

nonstep variable speed gear 5 may arrange the motor 4 upstream of the nonstep variable speed gear 5, as shown in drawing 3, and as shown in drawing 4, they may arrange the motor 4 downstream from the nonstep variable speed gear 5. The rotor of the motor 4 is penetrated, the output shaft of the clutch 3 is directly linked with the human power axis of the nonstep variable speed gear 5, and one axis constitutes the output side of the clutch 3 from the example of arrangement shown in drawing 3. The input shaft of the nonstep variable speed gear 5 is penetrated, the output shaft of the clutch 3 is directly linked with the output shaft of the motor 4, and one axis constitutes the output side of the clutch 3 from the example of arrangement shown in drawing 4. In any case, the motor 4 is connected with the input shaft of the nonstep variable speed gear 5.

[0035]While arrangement of a power train is not limited to the example of arrangement shown in drawing 3 and drawing 4 but connects the engine 2 and the motor 1 with the input shaft of the clutch 3, The input shaft of the motor 4 and the nonstep variable speed gear 5 is connected with the output shaft of the clutch 3, and if it is a screw style which tells power to the driving wheel 8 via the reduction gear 6 and the differential gear 7 from the output shaft of the nonstep variable speed gear 5, each apparatus will be materialized any arrangement.

[0036]It is making into the key objective for the above to show the fundamental example of composition of the hybrid vehicle which can apply this invention, to perform the optimal throttle control etc. in this invention at the time of the regenerative operation of such a hybrid vehicle, and to avoid generating of the torque level difference at the time of the end of regeneration. Next, it explains, referring to drawings per example of a control action of the example of outline composition of the throttle drive for it, and the controller 16.

[0037]The example of composition of the throttle drive which carries out electronic control of the throttle opening of the engine 2 mentioned above to drawing 6 is shown. The inside 22 and 27 of a figure is the accelerator pedal sensor and engine speed sensor which detect the control input of the accelerator pedal mentioned already, respectively. 34 is an air flow meter and detects the suction air quantity per unit time to the engine 2. 35 is a water temperature sensor and detects engine cooling water temperature. 36 is a fuel injection valve and 37 is an ignition plug. The throttle valve 39 is infixed in the suction passage 38 of the engine 2, and the actuator 40 which consists of a step motor etc. which drive this throttle valve 39 is formed. The actuator 40, So that it may become an outputted throttle opening required of an engine from the output requirement fundamentally judged according to the control input of an accelerator pedal based on the signal from the accelerator sensor 22. While the accelerator opening sensors 28 (refer to drawing 2) detect a real opening, feedback control is carried out by the controller 16. However, correction control is carried out so that it may become a predetermined throttle opening based on the signal from the engine speed sensor 27 at the time of a regenerative operation. 41 in a figure is a pressure sensor which detects the intake pipe

pressure of the downstream rather than the throttle valve 39, and when carrying out feedback control of the intake pipe negative pressure and controlling the opening of the throttle valve 39, it is used.

[0038]Drawing 7 shows the details of this throttle control. In this control, the target torque TTI of the net which should subtract and add offset amount TEOFS(s) which the motor 4 has generated to the target torque first determined from the control input of the accelerator pedal, such as load torque of driving force and an air-conditioner, and the engine 2 should generate is computed (refer to the A section of drawing 7). KTEH is a learning correction amount of an offset amount. Next, based on the target torque TTI and the engine speed value NE at that time, the volumetric flow rate TGADNV of required suction air for every cycle is calculated by table search, and it asks for the required effective area product TQHOTE of an inlet pipe by table search further after this (refer to the B-C part). Since this TQHOTE is unit quantity, it asks for the effective area product TTAETD which multiplies this by an engine speed value and cylinder capacity, and is equivalent to the engine total suction air quantity, and this is changed into throttle valve TGTVO by table search (refer to the D-E part). Said TGTVO is a thing used as the target throttle opening in the usual operational status broken into the accelerator pedal, The necessary throttle opening has been obtained by carrying out feedback control of the actuator 40 (refer to drawing 6), detecting (refer to the said F section) and a real opening, after restricting the opening variation speed by a variation speed limiting circuit to this for operational stability.

[0039]On the other hand, at the time of the slowdown to which a fuel cut is performed, the throttle opening value TGTVFC at the time of the fuel cut for which it asked by table search from the engine speed value NE is outputted as target throttle opening TGTVO (refer to the G section). It is set as the required limit where generating of a torque level difference is avoidable, the throttle opening at this time raising regenerative efficiency, as mentioned already. TVBCV is a lower limit of the throttle opening given by the table according to the engine speed value NE so that intake pipe negative pressure may not become excessive (refer to the H section).

[0040]Next, the embodiment about the throttle opening control at the time of the fuel cut mentioned above is described. Drawing 8 is a control characteristic diagram showing a 1st embodiment, and is equivalent to the table of the G section in drawing 7. Although he is trying to avoid generating of the torque level difference at the time of resumption of fuel supply, this example making a throttle opening necessary minimum, and raising regenerative efficiency by decreasing a throttle opening as are illustrated and an engine speed value decreases fundamentally, In addition, the amount of target regeneration is detected and the target throttle opening for every engine speed value is amended. Since the slowdown operation of this by the generating load of the motor 1 or 4 decreases when there are few amounts of regeneration as

mentioned already, only the part closes a throttle and it secures the slowdown power by an engine brake effect. The amount of target regeneration is computed with the signal from the battery SOC sensing device 26 (drawing 2). In the engine provided with the good change valve gear which carries out variable control of the operating angle and lift amount of an induction-exhaust valve according to an engine speed value, Since pump loss changes according to the operating state of a good change valve gear, it is desirable to amend a target throttle opening so that the necessary amount of regeneration thru/or deceleration may be obtained in consideration of this change.

[0041]Drawing 9 is a flow chart showing the control action under slowdown by a 2nd embodiment. This computes the size of a torque level difference based on the engine speed and the target throttle opening at the time of the end of regeneration, and avoids generating of a torque level difference by driving the rotation electrical and electric equipment and compensating the torque for this level difference.

[0042]It is judged whether after reading target throttle opening TGTVO first in this control, the fuel cut state is continuing, If it is during a fuel cut, it will determine that the amount of target regeneration will become the regenerated torque defined from the table as shown in drawing 10 based on the vehicle speed at that time, and regenerative operation will be performed (Steps 901-904).

[0043]If treading-in operation of an accelerator pedal etc. are made by a deceleration process, fuel supply will be resumed and regenerative operation will be ended. At this time, if it is immediately after a fuel cut, the engine speed NE and target throttle opening TGTVO at that time will be read as preparation for computing the compensating torque which cancels a torque level difference (Steps 905-906). Next, the variation dTVO of a throttle opening is calculated for the target throttle opening read at Step 901 from the difference of this and this value TGTVO as the previous value TGTVOp, A table as shown in drawing 11 based on this and the number of rotations NE is searched, compensating torque Tmta is set up, and a motor is driven so that this compensating torque may be outputted (Steps 907-908,912). Thus, generating of a torque level difference is avoided by the torque equivalent to the torque level difference at the time of resumption of fuel supply being compensated by a motor.

[0044]Since it is judged with it not being immediately after resumption of fuel supply at Step 905 in subsequent control loops, 909 or less-step processing is started. This is processing for changing real torque to the output equivalent to a target throttle opening gradually by reducing compensating torque gradually. For the purpose, read the number of rotations NE first, and the amendment damping time constant equivalent value Kfc (however, Kfc<1) is searched from a table as shown in drawing 12 based on NE, A motor is driven by setting to new compensating torque Tmta what multiplied the previous value Tmtap of compensating torque by Kfc (Steps 909-912). Thereby, since the motor torque for torque level difference compensation decreases

gradually, the torque inputted into a drive system can be changed smoothly, and good operability can be secured.

[Translation done.]